Electronic Version
Stylesheet Version v1.1.1

Description

TOOL HOLDER ASSEMBLY

BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a tool holder assembly, and more particularly to a tool holder assembly incorporating an adapter configured to deliver a fluid to a cutting tool.

[0003] 2. Background Art

[0004] Previously, drill chucks incorporated a fluid supply hole adapted to receive a straight shank of an oil-through-drill, as described in U.S. Patent No. 5,649,714. In that patent, a seal block was positioned in the fluid supply hole to regulate fluid flow into a fluid channel of the oil-through-drill and into a gap portion between the fluid supply hole and the straight shank portion. Such drill chucks did not address the desirability of gap-free sealing between a cutting tool and an adapter to inhibit fluid leakage and improve tool life. Moreover, such drill chucks

were not configured for use with a minimum quantity lubrication (MQL) machining system in which very limited amounts of lubricant are provided at high pressure to the cutting surfaces of the cutting tool to sustain the machining process. In addition, such chucks did not incorporate adjustment screws to facilitate the axial positioning of the cutting tool.

[0005] Before Applicants' invention, there was a need for a tool holder assembly that was compatible with an MQL machining system and facilitated the supply of pressurized fluid to the cutting surfaces of a cutting tool while inhibiting fluid leakage. In addition, there was a need to incorporate the functionality of an adjustment screw to accurately position the cutting tool without the need to manufacture, position, and install a separate adjustment screw component. Problems associated with the prior art as noted above and other problems are addressed by Applicants' invention as summarized below.

Summary of Invention

[0006] According to one aspect of the present invention, a tool holder assembly is provided. The tool holder assembly includes a cutting tool, a tool holder, and an adapter. The cutting tool includes a main portion, an end portion, and a

fluid passage. The main portion has a first diameter. The end portion has a second diameter and is disposed proximate the main portion. The fluid passage is disposed in the main and end portions. The tool holder includes a conduit and a counterbore. The counterbore is adapted to receive the cutting tool and is axially aligned with the conduit. The adapter includes a tool receiving portion, a body portion, and an internal fluid passage. The tool receiving portion is configured to receive the end portion. The body portion is disposed proximate the tool receiving portion and is adapted to engage the conduit. The internal fluid passage is defined by the tool receiving and body portions and is adapted to provide a fluid from the conduit to the fluid passage.

[0007] The internal fluid passage may include a chamfer disposed proximate the tool receiving portion that is adapted to direct fluid to the fluid passage.

[0008] The adapter may include a first internal fluid passage disposed in the body portion and a second and third internal fluid passages disposed in the tool receiving portion proximate the first internal fluid passage.

[0009] The counterbore may include a bottom surface. A spring may be disposed between the tool receiving portion and

the bottom surface for biasing the adapter against the end portion.

[0010] A seal may be disposed between the end portion and the tool receiving portion for inhibiting fluid leakage.

[0011] According to another aspect of the present invention, a tool holder assembly is provided. The tool holder assembly includes a cutting tool, a tool holder, an adapter, and a spring. The cutting tool includes a main portion, an end portion, and a fluid passage. The main portion has a first diameter. The end portion has a second diameter. The fluid passage is disposed in the main and end portions. The tool holder is configured to rotate about an axis of rotation and includes a conduit and a counterbore. The counterbore is adapted to receive the cutting tool and has a bottom surface. The adapter includes a tool receiving portion, a body portion, and an internal fluid passage. The tool receiving portion is configured to receive the end portion. The body portion is disposed proximate the tool receiving portion and is adapted to engage the conduit. The internal fluid passage is defined by the tool receiving and body portions and is adapted to provide a fluid from the conduit to the fluid passage. The spring is configured to bias the adapter against the cutting tool to inhibit fluid

leakage.

[0012] The adapter may be configured to flex about the axis of rotation to facilitate insertion of the adapter into the conduit.

[0013] According to another aspect of the present invention, a tool holder assembly is provided. The tool holder assembly includes a cutting tool and a tool holder. The cutting tool includes a main portion and an adapter portion. The main portion has a first diameter and a first fluid passage. The adapter portion is disposed proximate the main portion and has a second diameter and a second fluid passage disposed coaxially with an axis of rotation and connected to the first fluid passage. The tool holder includes a conduit and a counterbore. The conduit is adapted to receive the adapter portion and provide a fluid to the second fluid passage. The counterbore is adapted to receive the cutting tool and is axially aligned with the conduit.

Brief Description of Drawings

[0014] Figure 1 is a section view of a first embodiment of a tool holder assembly.

[0015] Figure 2 is a section view of a second embodiment of the tool holder assembly.

[0016] Figure 3 is a section view of a third embodiment of the

tool holder assembly.

[0017] Figure 4 is a section view of a fourth embodiment of the tool holder assembly.

Detailed Description

[0018] Referring to Figure 1, one embodiment of a tool holder assembly 10 is shown. In this embodiment, the tool holder assembly 10 includes a cutting tool 12, a tool holder 14, and an adapter 16.

[0019] The cutting tool 12 includes a shank or main portion 20, an end portion 22, one or more cutting surfaces 24, and one or more fluid passages 26. The cutting tool 12 may have any suitable configuration and may be of any suitable type, such as a chamfer tool, counterbore, drill, mill, reamer, or tap.

[0020] The end portion 22 is disposed proximate the main portion 20. The end portion 22 may have any suitable configuration for mating with the adapter 16. In the embodiment shown in Figure 1, the end portion 22 has a male configuration and a smaller diameter than the main portion 20. In addition, the end portion 22 may have a generally planar, contoured, or chamfered end surface that helps position or center the cutting tool 12.

[0021] The fluid passages 26 extend through the cutting tool 12

and are configured to provide a fluid proximate the cutting surface 24. The fluid passages 26 may have any suitable configuration. In the embodiment shown in Figure 1, the fluid passages 26 are aligned generally parallel to and spaced apart from an axis of rotation 28.

[0022] The tool holder 14 is configured to hold the cutting tool 12 and rotate about the axis of rotation 28. More specifically, the tool holder 14 is configured to be connected to a spindle or other suitable device that is adapted to rotate the tool holder 14. The tool holder 14 may be of any suitable type, such as shrink fit holder or chuck. Also, the tool holder 14 may be made of any suitable material, such as a polymeric material or a metal.

[0023] The tool holder 14 includes a counterbore 30 and a conduit 32. The counterbore 30 is adapted to receive the cutting tool 12 and includes a bottom surface 34. The counterbore 30 may have any suitable configuration for receiving and holding the cutting tool 12. Optionally, the cutting tool 12 may be secured to the tool holder 14 in any suitable manner, such as with one or more set screws as is known by those skilled in the art.

[0024] The conduit 32 is adapted to provide a fluid to the cutting tool 12. For example, the conduit 32 may be connected to

a fluid supply pipe or fluid source that is adapted to provide any suitable fluid, such as a coolant or lubricant in the form of an aerosol, gas, or liquid. The conduit 32 may have any suitable configuration. For example, the conduit 32 may be integrally formed with the tool holder 14, may be a separate component attached to and extending through the tool holder 14, or may be defined by a combination of integrally formed tool holder surfaces and separate components. In the embodiment shown in Figure 1, the conduit 32 includes a narrow portion 36 of the tool holder 14 and a pipe 38 coupled to the tool holder 14 with a fastener 40. Also, the conduit 32 may be disposed concentrically with the axis of rotation 28 and may have a smaller inside diameter than the counterbore 30.

[0025] The adapter 16 includes a body portion 50 and a tool receiving portion 52. The adapter 16 is configured to receive the end portion 22 to inhibit fluid leakage and help position the cutting tool 12. The adapter 16 may be made of any suitable material, such as a polymeric material or a metal.

[0026] The body portion 50 and the tool receiving portion 52 cooperate to define an internal fluid passage 54. The internal fluid passage 54 may be disposed coaxially with the

conduit 32.

[0027] The body portion 50 is adapted to engage the conduit 32. More specifically, the body portion 40 may be configured to attach to or seal against the inside of the conduit 32 to inhibit fluid leakage. The body portion 50 may have any suitable configuration. In the embodiment shown in Figure 1, the body portion 50 includes a first section 56 disposed proximate the pipe 38 and a second section 58 disposed proximate the narrow portion 36. Alternatively, the second section 58 may be omitted and the first section 56 may extend from the bottom surface of the tool receiving portion 52. Optionally, the first or second sections 56,58 may have a threaded portion disposed on an exterior surface.

[0028] The tool receiving portion 52 may include a socket or recess 60 adapted to receive the cutting tool 12. More specifically, the recess 60 may have a similar configuration as the end portion 22. Optionally, the recess 60 may have a larger outside diameter than the body portion 50 to help position the adapter 16 within the counterbore 30.

[0029] The adapter 16 may include a chamfer 62 disposed in the recess 60 proximate the internal fluid passage 54 to improve fluid flow and fluid distribution to the fluid pas-

sages 26. More particularly, the chamfer 62 and centrifugal forces present when the tool holder assembly 10 is rotated cooperate to direct fluid from the internal fluid passage 54 outward to the fluid passages 26.

[0030] Optionally, a seal 70 may be disposed between the tool receiving portion 52 and the end portion 22 to further inhibit fluid leakage. The seal 70 may have any suitable configuration. In one embodiment, the seal 70 is at least partially disposed in a groove located on the end portion 22 or the tool receiving portion 52.

[0031] In addition, adapters having different configurations may be associated with each type or size of cutting tool. For example, adapters wherein the first and/or second sections 56,58 have different geometries or cross-sections for each tool may be employed to help insure that the correct adapter is used with a particular cutting tool.

[0032] Referring to Figure 2, a second embodiment of the tool holder assembly 100 is shown. In this embodiment, the tool holder assembly 100 includes a cutting tool 112 and a tool holder 114 having an integral adapter portion 116.

[0033] The cutting tool 112 includes a main portion 120, one or more cutting surfaces 124, one or more fluid passages 126, and may be rotatable about an axis of rotation 128

as previously described.

[0034] The tool holder 114 includes a counterbore 130 and a conduit 132. The counterbore 130 has a bottom surface 134. The conduit 132 may have any suitable configuration and may include a narrow portion 136 and/or a pipe 138 coupled to the tool holder 114 with a fastener 140 as previously described.

[0035] The adapter portion 116 includes an internal fluid passage 154. In the embodiment shown in Figure 2, the internal fluid passage 154 also extends partially into the main portion 120. The adapter portion 116 may also have a first section 156 disposed proximate the pipe 138 and a second section 158 disposed proximate the narrow portion 136.

[0036] A chamber 160 may connect the internal fluid passage 154 and the tool fluid passages 126. The chamber 160 may include a tapered surface or chamfer 162 to improve flow and distribution to the fluid passages 126 as previously described.

[0037] Referring to Figure 3, a third embodiment of the tool holder assembly 200 is shown. Similar to Figure 1, the tool holder assembly 200 includes a cutting tool 212, a tool holder 214, and an adapter 216.

[0038] The cutting tool 212 may include a main portion 220, one or more cutting surfaces 224, a plurality of fluid passages 226, and may be rotatable about an axis of rotation 228 as previously described.

[0039] The tool holder 214 includes a counterbore 230 and a conduit 232. The counterbore 230 has a bottom surface 234. The conduit 232 may have any suitable configuration and may include a narrow portion 236 and/or a pipe 238 coupled to the tool holder 214 with a fastener 240 as previously described.

[0040] The adapter 216 may include a body portion 250 and a tool receiving portion 252, as previously described. The body portion 250 may also include a first internal fluid passage 254, a first section 256 disposed proximate the pipe 238 and a second section 258 disposed proximate the narrow portion 236.

[0041] The tool receiving portion 252 includes a plurality of additional fluid passages. In one embodiment, the tool receiving portion 252 includes second and third internal fluid passages 260,262 connected to the first internal passage 254 and to different tool fluid passage 226. The first and/or second internal fluid passages 260,262 may be angled or include a curved or tapered surface to im-

prove fluid flow and distribution to the tool fluid passages 226.

[0042] Referring to Figure 4, a fourth embodiment of the tool holder assembly 300 is shown. In this embodiment, the tool holder assembly 300 includes a cutting tool 312, a tool holder 314, an adapter 316, and a spring 318.

[0043] The cutting tool 312 may include a main portion 320, an end portion 322, one or more cutting surfaces 324, one or more fluid passages 326, and may be rotatable about an axis of rotation 328 as previously described.

[0044] The tool holder 314 includes a counterbore 330 and a conduit 332. The counterbore 330 has a bottom surface 334. The conduit 332 may include a narrow portion 336 and/or a pipe 338 coupled to the tool holder 314 with a fastener 340.

[0045] The adapter 316 may include a body portion 350, a tool receiving portion 352, and an internal fluid passage 354, a first section 356, a second section 358, a recess 360, and a chamfer 362 as previously described.

[0046] The spring 318 is adapted to engage the tool receiving portion 352 and the bottom surface 340 to bias the adapter 316 into engagement with the end portion 322 to position the tool and inhibit fluid leakage.

[0047] The tool holder assemblies 10,100,200,300 described above may be employed with any suitable machining process or fluid delivery system. For example, the tool holder assemblies 10,100,200,300 may be used with a minimum quantity lubrication (MQL) system. In an MQL system, a pressurized lubricating fluid, such as an oil mist, is provided through the tool holder 14,114,214,314 and cutting tool 12,112,212,312 to the cutting surfaces 24,124,224,324. Fluid delivery is controlled to provide just enough lubrication to sustain the machining process. Consequently, it is desirable to provide gap-free sealing between the cutting tool 12,112,212,312 and the adapter 16,216,316 or conduit to inhibit fluid leakage and improve tool life. Providing gap-free sealing without manual intervention or manual adjustments to a tool positioning screw is desirable to help insure quality of the finished part. For example, gap-free sealing without manual adjustments is desirable in processes that "reuse" tools by regrinding or resharpening cutting surfaces and thereby alter the tool length.

[0048] While the best mode for carrying out the invention has been described in detail, those familiar with the art to which this invention relates will recognize various alterna-

tive designs and embodiments for practicing the invention as defined by the following claims.